GEOPHYSICAL MODEL OF DIAMOND PIPES

COX AND SINGER Model No. 12
Geophysically similar models-No. 10 Carbonatites;
No. 29b, Olympic Dam

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A. Geologic Setting

- Kimberlite or lamproite diatremes emplaced along zones of basement weakness within or on the margins of stable cratons; often in groups of three or more (Dawson, 1971).
- Often spatially related to carbonatites, but not normally occurring along same zones of crustal weakness (Dawson, 1967; Garson, 1984). A genetic relationship is open to question.

B. Geologic Environment Definition

Regional magnetic, gravity, and remote sensing surveys may identify deep-seated fracture systems and related anteclises or syneclises that define zones of weak crust favorable for emplacement (de Boarder, 1982; Tsyganov, and others, 1988) .

C. Deposit Definition

Individual diatremes generally appear as circular to elliptical bodies in remote sensing images, and on magnetic, gravity, or resistivity maps. The diatremes may show as distinct magnetic highs (Yakutia, West Africa) of hundreds to a few thousand nT, but high remanence or magnetic host rocks can result in negative or no anomalies. Gravity (order of 1 mgal), resistivity, and seismic velocity anomalies generally show as lows over the diatremes related to serpentization and weathering of the mafic rocks. Radioelement surveys have generally not been effective, although in Yakutia Fedynsky and others (1967) report that they have been used to differentiate between diamond-bearing basaltic kimberlites from barren micaceous kimberlites and carbonatites (da Costa, 1989; Kamara, 1981; Gerryts, 1970; Macnae, 1979; Guptasarma and others, 1989).

D. **Size and Shape of**

Size and Shape of	Shape	Average Size/Range
Deposit	Vertical cone, carrot-like	0.1 to 5 km diameter; generally 0.4 to 1 km depth to about 2 km
Alteration haloe	Irregular about pipe	thin, not geophy. significant
Cap	Elliptical cylinder	0.1 to 5 km, 0-10’s m thick

E. Physical Properties (units)	Deposit	Alteration	Cap	Host
	kimberlites or lamproite pipe	Si, CO_2, K metasomatism	clay-rich weathering zone-blue and yellow ground	any cratonic unit
1. Density (gm/cm^3)	2.75[5] 2.64-3.12[2,5,11] 2.35-2.55[8]	?	2.35?[13] 2.5-2.62[2]	*
2. Porosity	low-moderate	low?	high[2]	*
3. Susceptibility (cgs)	$1x10^{4}$-$1x10^{-2}$[8] to $2.3x10^{-3}$[6]	?	$1x10^{-5}$-$1x10^{-3}$[8] to $2x10^{-5}$[6]	*
4. Remanence	variable 0-0.8-2.0[13]	?	variable	*
5. Resistivity (ohm-m)	100-2000[2,8,11,13]	medium-high	2-100[2,8,11,13]	*
6. IP Effect (msec.)	low	low?	low,0-4[10]	*
7. Seismic Velocity (km/see)	2.6-3.3[2]	high?	1.5[2]	*
8. Radioelements				
K (%)	2.6 average 0.07-6.7[1]	medium	medium?	*
U (ppm)	0.26, average 0.07-0.8[1]	low	very low	*
Th (ppm)	0.44, average 0.17-0.9[1]	low	low	*

F. Remote Sensing Characteristics

Visible and near IR- lineaments may reflect zones of crustal weakness along which pipes were emplaced. Lineament intersections may be favored locations (Tsyganov and others, 1988). Vegetation anomalies related to drainage and lithologies can be used for location. Alteration products of kimberlites, such as serpentine, chlorite, and vermiculite show distinct spectral absorption features that can be detected (Kingston, 1989).

G. Comments

The relatively small size, 0.4-l.km, of most pipes requires detailed coverage for identification. Signature differs from carbonatites in reduced amplitude of magnetic anomaly, and by a small negative gravity anomaly in contrast to the large positive anomaly of carbonatites. A combination of magnetic, gravity, and resistivity methods is most used in exploration. No single method is universally applicable. Radioelement methods have had relatively little use, although they should have some application in differentiating varieties of kimberlites and lamproite. Some Russian literature (Ratnikov, 1970) gives very low values of density for kimberlites. These probably refer to serpentinized or weathered samples and are not representative of unaltered rock. Gerryts (1967) gives a rule-of-thumb of 1 mgal/183 meters (200 yards) of pipe diameter for the gravity low. A broad gravity high ring about the central low, and due to dense, deeper, kimberlites has not been observed. Guptasarma and others (1989) report both positive and negative gravity and magnetic responses over kimberlites in India.

H. References

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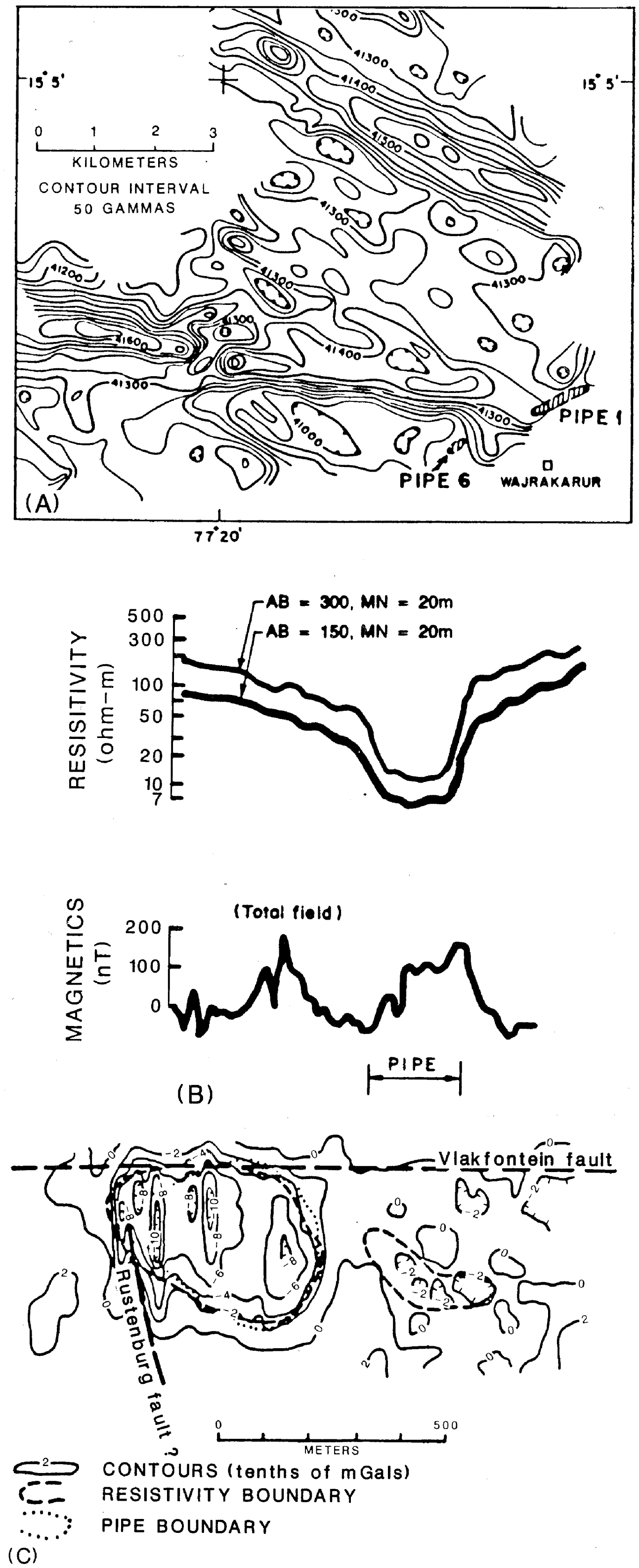

Figures A. Strong regional magnetic linear adjacent to two kimberlite pipes in the Wajrakarur area, Andhra Pradesh, India adapted from Guptasarma and others (1989). Contour interval is 50 gamma. B. Resistivity and ground magnetic traverse across the Palmietfontein pipe South Africa adapted from da Costa (1989). C. A residual gravity map of the Palmietfontein pipe also showing its emplacement at the junction of the Vlakfontein and Rustenburg faults, after da Costa (1989).